Space Weather Technical Forecast

Issued on Thursday, 06 April 2023 at 00:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with no significant flares. There are two sunspot regions on the visible disc. AR3270 is the most prominent region on the disc, in the southwest quadrant, which has contained a transient delta spot over the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1 started the period at elevated levels around 520 km/s and have now declined to slightly elevated around 420 km/s, which may indicate a weakening of the high speed stream. Solar wind density started at slightly above average levels and is now at near average to slightly below average. Magnetic field strength has been weak throughout, with the north-south component, Bz, also varying weakly. The Phi angle has been mostly negative (towards the Sun). Geomagnetic activity has been Quiet to Unsettled, with one Active interval.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has been at background levels. The high energy electron flux (greater than 2MeV), as measured at GOES16, reached high levels at the diurnal maximum period with a peak of 3210 pfu at 05/1625 UTC, and is now at moderate levels. Electron fluence remained at just below the Active threshold, with a steady trend, and is at 9.2e7 integrated pfu at 06/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a slight chance (10%) of Moderate activity, if an M-class flare occurs.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast to affect the Earth through the next four days. Solar winds are now declining following the High Speed Stream (HSS) related to a combination of coronal holes 89 and 90 that have affected Earth. Solar winds are forecast to decline a little further over the next 24 hours with little change likely for the remainder of the period. Geomagnetic activity is forecast to be Quiet to Unsettled, with a chance of Active intervals, especially on Day 1 (6 Apr).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES-16 is at background levels and is likely to remain so, in the absence of significant flare activity. Electron flux values are likely to continue at mostly moderate to high levels. Electron fluence is likely to be near or just below the Active (1e8 integrated pfu) threshold, perhaps increasing slightly through the period.

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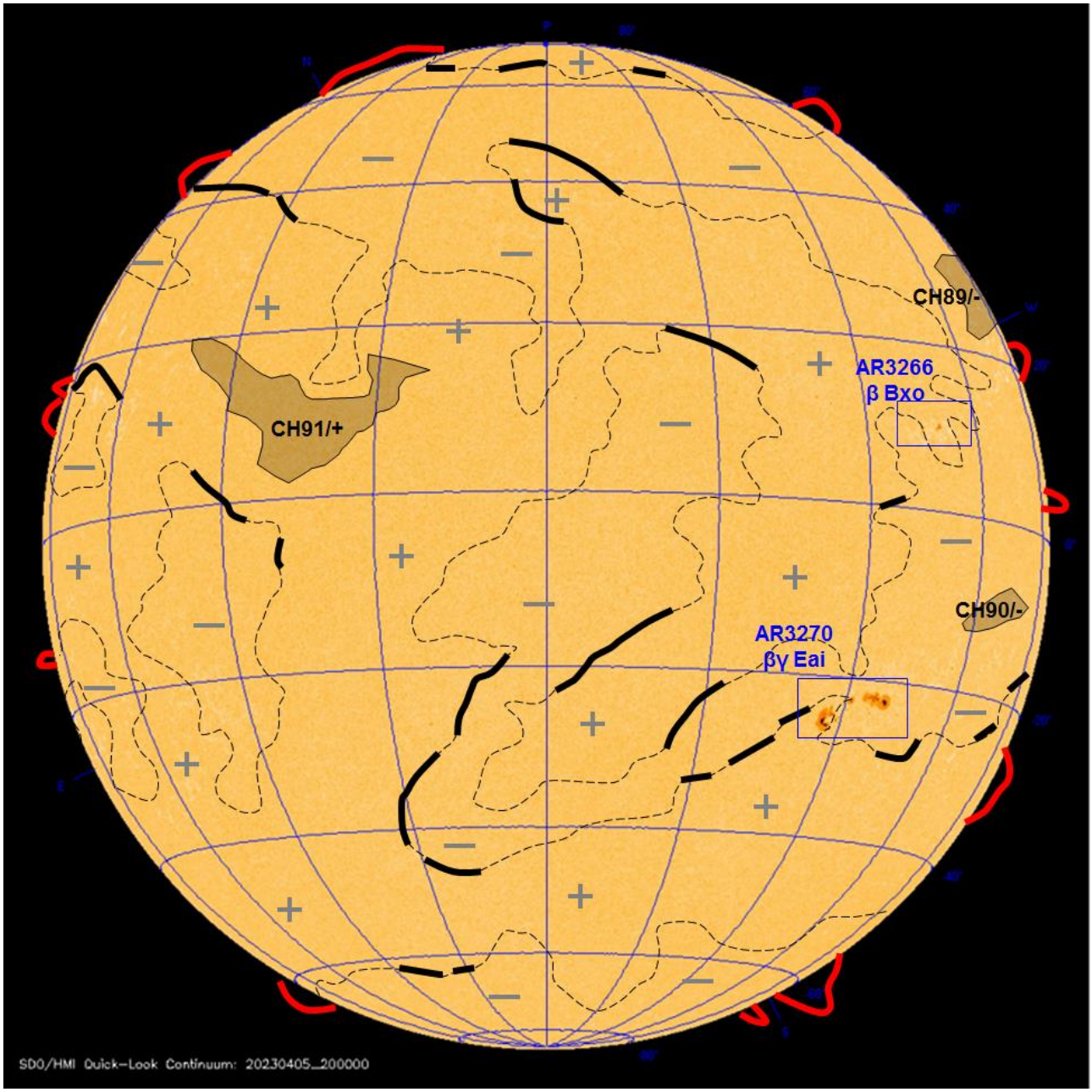
Figure 1. Solar Analysis Valid 2000UTC, 5 April 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

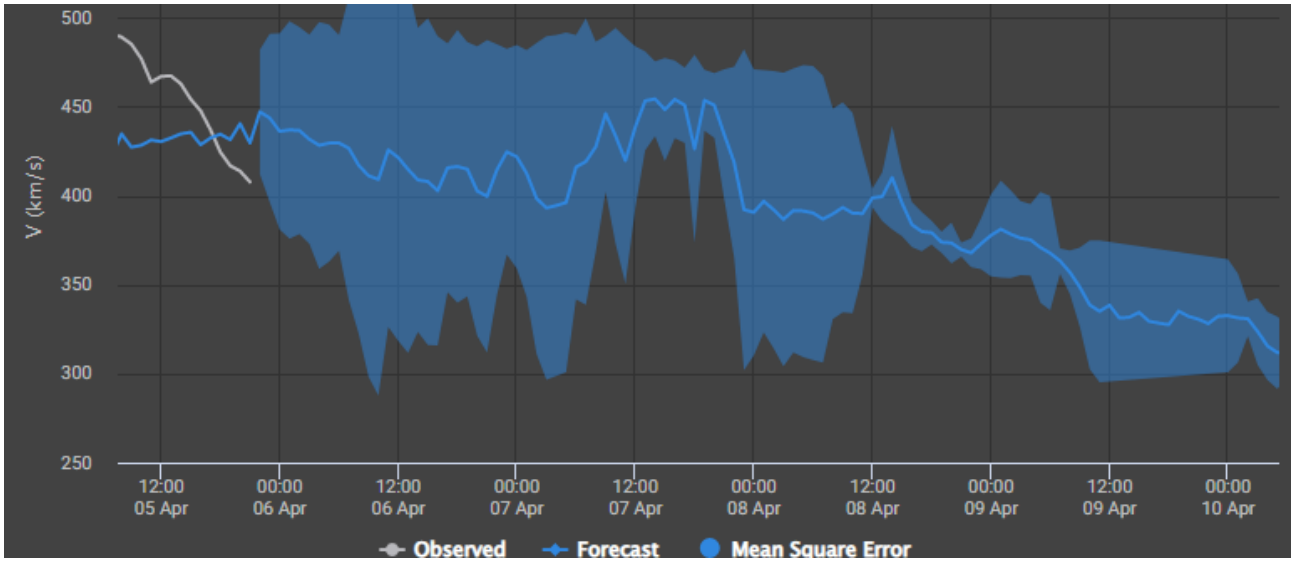
There are no Earth-directed CMEs expected. Two coronal hole high speed streams that have affected solar winds, are forecast to continue a slow decline in the next 24 hours with no further high speed streams expected to connect with Earth. Solar winds then probably remaining near or just below 400 km/s for the remainder of the guidance period. Geomagnetic activity is forecast to be Quiet to Unsettled, with a slight chance (10%) of Active intervals, this most likely during the next 24 hours.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	3	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model (SWPM) with little overall change likely.



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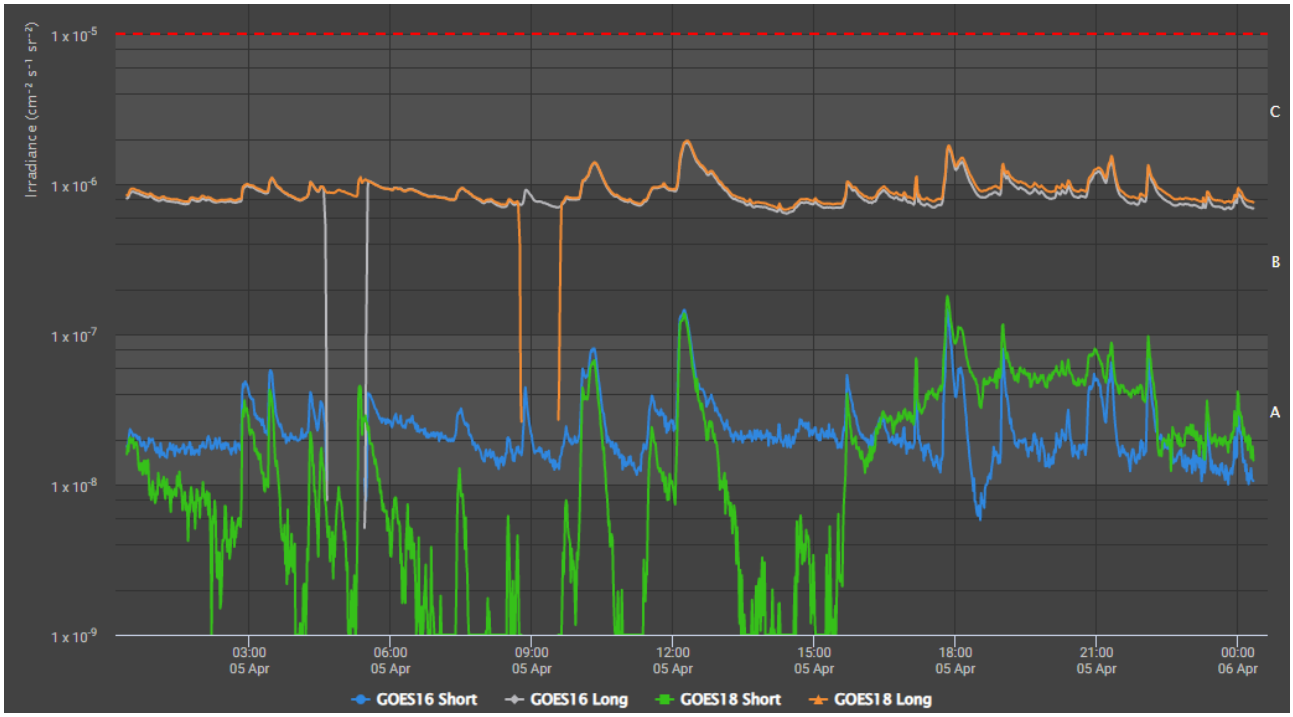
Radio Blackouts - X-Ray Flares:
There are four sunspots on the visible disc, with AR3270 the most prominent feature, carrying the highest risk. The region has occasionally developed a weak delta spot, but currently appears rather more simplified and with a delta spot not in evidence. The remaining region is a relatively simple and has bi-polar characteristics. Low levels of solar activity are expected with a daily slight chance (10%) of Moderate activity, if an isolated M-class flare occurs during the guidance period.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	10	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux plot at GEO with date from GOES with low level C-class activity continuing.



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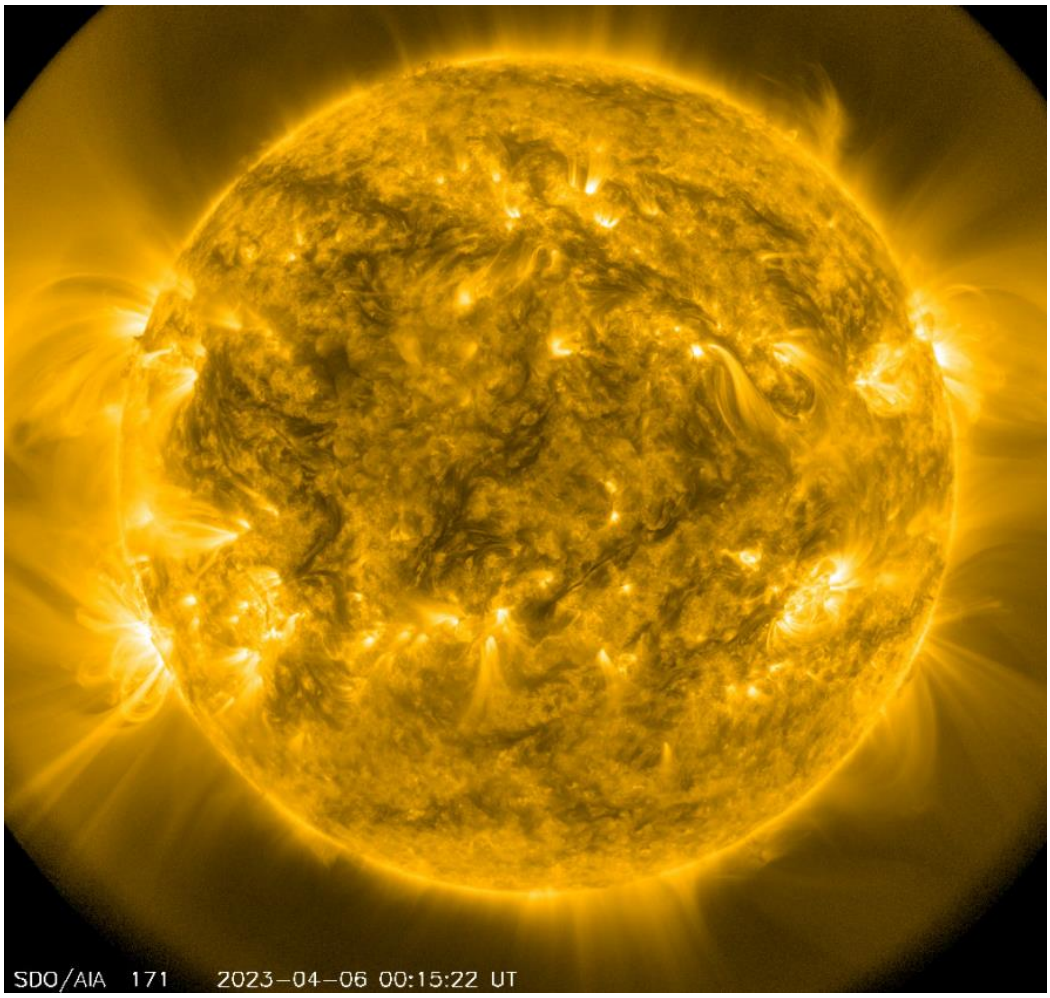
Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV), as observed by GOES-16, is forecast to remain at background levels, pending any significant sunspot development. There is an extremely slight chance of protons reaching the S1 level, most likely from AR3270 which is in a good position to connect with Earth should a larger flare occur in the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	3	3	3	3
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO aia-171 imagery showing magnetic looping across the visible solar disc.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is forecast to oscillate between moderate and high (1000 pfu) through the forecast period, as the solar wind eases, reducing the rate of electron inputs into the radiation belts. High levels are still likely during the diurnal peaks, but with a decreasing magnitude. However the British Antarctic Survey Radiation Belt Model (BAS-RBM) is forecasting a build of high energy electron density at lower orbits, which could relax towards GEO as the solar wind speed, and by inference, pressure eases.

Electron fluence has been at relatively steady levels and remains just below the active threshold, and probabilities have been kept at relatively high values to account for the active threshold being breached, which is likely over the next few days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	70	70	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output over past three days.

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